PLGA sub-micron particles by Nano Spray Drying

Nano Spray Dryer B-90 HP
Nano-spray drying for drug delivery of smallest particles

1. Introduction

In the past decades, biopolymers based on lactic acid and glycolic acid and their copolymers have attracted much interest as carriers in the preparation of different medical devices and drug delivery systems due to their excellent biocompatibility, biodegradability and non-toxicity in humans [1]. PLGA polymers are commercially available and approved by the US Food and Drug Administration (US FDA) for human use at various molecular weights and lactid/glycolide ratios. They are commonly used for controlled release of various molecules and several products can be found on the market [2].

Spray-drying was shown to be a rapid, continuous, cost-effective, reproducible and scalable process for the production of dry powders from a fluid [3]. Besides, due to its advantages, spray drying is used in several occasions to develop PLGA micro- and nanoparticles [2].

Aim of this Application Note is to give an application help in spray drying biodegradable polymers such as PLGA using the Nano Spray Dryer B-90 HP combined with the Inert Loop B-295. The use of the Inert Loop B-295 enables to dry solutions or suspensions of organic solvents in a fully closed system, maximizing user safety and minimizing solvent waste.

Here, the polymer type and the influence of the concentration on the particles characteristics are studied.

2. Experimental

Figure 1: Experimental set-up of the Nano Spray Dryer B-90 HP with the Inert Loop B-295 and the Aspirator.

A solution of 0.1 % PLGA (RG504H Evonik Rohm GmbH, Essen, Germany) was prepared in acetonitrile (ACN). A second solution of 0.1 % PLGA and 0.005 % sodium acetate was prepared in a mixture of 95 % ACN and 5 % water. All solutions were prepared as % [w/V] solutions if not mentioned otherwise.

Sub-microparticles were produced by spray drying the solutions of PLGA using the tall set up of the Nano Spray Dryer B-90 HP. The Spray Dryer was operating in closed loop mode, using the inert loop B-295 (Figure 1). Moreover, the experiments were run using the medium size nebulizer with an inlet temperature of 55 °C and a flow rate of 140-160 L/h, the pump was set at 20 %, the spray at 50 % and the frequency at 110 kHz.

3. Results

When spraying PLGA dissolved in a pure ACN solution, a small swirling spray is observed and droplets are forming on the spray head due to poor electrical conductivity of the solution. The addition of 5 % water does not improve the spray and the droplet formation, therefore, the conductivity of the solution was improved by addition of 0.005 % of sodium acetate. The addition of salt resulted in a conical spray with a throughput of 106 mL/h.
By spray drying 0.1 % PLGA and 0.005 % sodium acetate in a mixture of 95 % ACN and 5 % water, spherical particles from 156 nm to 2µm were produced (Figure 2), with the majority of the population below 1 µm.

Using the medium size mesh of the B-90 HP, a 5 fold improvement in throughput is observed compared to this obtained by Amsalem et al. (2016), without increasing particle size. The obtained particles have indeed sizes similar than those obtained by Amsalem *et al*. (2016) using the 4 µm spray cap of the previous version of the Nano Spray Dryer B-90.

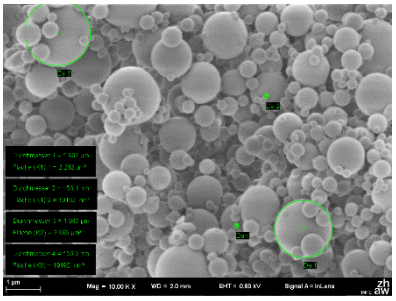

Figure 2 : Sub-micron PLGA spheres obtained by spray drying.

4. Conclusion

PLGA particles were produced using the Nano Spray Dryer B-90 HP showed a spherical shape and a size distribution from 2 µm to below 0.2 µm. These results are similar to those observed by Amsalem et al. (2016) [4]. The obtained throughput using the new nebulizer system is improved compared to this of Amsalem et al. (2016) when using the medium nebulizer which correspond to the previous 4 µm mesh [4]. By replacing the medium mesh by the small mesh, it could therefore be assumed that that particles below 150 µm could be achieved with the Nano Spray Dryer B-90 HP.

References

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